

# Claims

- [c1] 1. A method for merging an original circuit shape and at least one overlapping clone of the original circuit shape of an IC design, the method comprising the steps of:
- determining, for a cell including an original circuit shape and at least one overlapping clone of the original circuit shape, whether each clone corner point of each overlapping clone is within a threshold distance of a corresponding original corner point of the original circuit shape; and
  - generating, in the case that each clone corner point of each overlapping clone is within the threshold distance, a union of each overlapping clone and the original circuit shape such that the union does not contain a notch.
- [c2] 2. The method of claim 1, wherein the generating step includes:
- determining a shape direction of the original circuit shape;
  - determining, for each original corner point of the original circuit shape that has at least one corresponding clone corner point that is not identical to

the original corner point, a previous edge orientation and a next edge orientation;  
for each original corner point having a previous and next edge orientation:  
selecting a point code from a plurality of point codes based on the previous and next edge orientations and the shape direction, the point code indicating which X coordinate and which Y coordinate among an original corner point and at least one corresponding clone corner point is selected to generate a union corner point;  
comparing respective coordinates of the original corner point and each corresponding clone corner point and selecting an X coordinate and a Y coordinate for the union corner point based on the point code; and  
generating the union based on any union corner points.

- [c3] 3. The method of claim 2, wherein:
- the previous and next edge orientations are each one of: vertical up, vertical down, horizontal left-to-right (LtoR), and horizontal right-to-left (RtoL);
  - the shape direction is one of clockwise and counter-clockwise; and
  - the point code includes high Y, low X (HYLX); high Y, high X (HYHX); low Y, low X (LYLX) and low Y, high X

(LYHX).

- [c4] 4. The method of claim 3, wherein the shape direction is determined by an order in which points appear in a construction list for the IC design.
- [c5] 5. The method of claim 3, wherein where the shape direction is clockwise, the selected point code is:
- a) for a vertical up previous edge orientation: HYLX for a horizontal LtoR next edge orientation and LYLX for a horizontal RtoL next edge orientation;
  - b) for a vertical down previous edge orientation: HYHX for a horizontal LtoR next edge orientation and LYHX for a horizontal RtoL next edge orientation;
  - c) for a horizontal LtoR previous edge orientation: HYLX for a vertical up next edge orientations horizontal LtoR and HYHX for a vertical down next edge orientation; and
  - d) for a horizontal RtoL previous edge orientation: LYLX for a vertical up next edge orientation and LYHX for a vertical down next edge orientation.
- [c6] 6. The method of claim 3, wherein where the shape direction is counter-clockwise, the selected point code is:
- a) for a vertical up previous edge orientation: LYHX for a horizontal LtoR next edge orientation and HYLX for a horizontal RtoL next edge orientation;

b) for a vertical down previous edge orientation: LYLX for a horizontal LtoR next edge orientation and HYHX for a horizontal RtoL next edge orientation;

c) for a horizontal LtoR previous edge orientation: LYHX for a vertical up next edge orientations horizontal LtoR and LYLX for a vertical down next edge orientation; and

d) for a horizontal RtoL previous edge orientation: HYHX for a vertical up next edge orientation and HYLX for a vertical down next edge orientation.

- [c7] 7. The method of claim 2, wherein for each original corner point of the original circuit shape that does not have at least one corresponding clone corner point that is not identical to the original corner point, coordinates of the original corner point are used to generate the union corner point.
- [c8] 8. The method of claim 1, further comprising the step of conducting a ground rule fix-up of the union.
- [c9] 9. The method of claim 1, further comprising the step of substituting the union in the IC design.
- [c10] 10. A system for merging an original circuit shape and at least one clone of the original circuit shape of an IC design, the system comprising:

means for determining, for a cell including an original circuit shape and at least one overlapping clone of the original circuit shape, whether each clone corner point of each overlapping clone is within a threshold distance of a corresponding original corner point of the original circuit shape; and  
means for generating, in the case that each clone corner point of each overlapping clone is within the threshold distance, a union of each overlapping clone and the original circuit shape such that the union does not contain a notch.

[c11] 11. The system of claim 10, wherein the generating means includes:

means for determining a shape direction of the original circuit shape;

means for determining, for each original corner point of the original circuit shape that has at least one corresponding clone corner point that is not identical to the original corner point, a previous edge orientation and a next edge orientation;

means for, for each original corner point having a previous and next edge orientation:

selecting a point code from a plurality of point codes based on the previous and next edge orientations and the shape direction, the point code indicating

which X coordinate and which Y coordinate among an original corner point and at least one corresponding clone corner point is selected to generate a union corner point;  
comparing respective coordinates of the original corner point and each corresponding clone corner point and selecting an X coordinate and a Y coordinate for the union corner point based on the point code; and  
means for generating the union based on any union corner points.

[c12] 12. The system of claim 11, wherein:  
the previous and next edge orientations are each one of: vertical up, vertical down, horizontal left-to-right (LtoR), and horizontal right-to-left (RtoL);  
the shape direction is one of clockwise and counter-clockwise; and  
the point code includes high Y, low X (HYLX); high Y, high X (HYHX); low Y, low X (LYLX) and low Y, high X (LYHX).

[c13] 13. The system of claim 11, wherein the shape direction determining means determines the shape direction based on an order in which points appear in a construction list for the IC design.

[c14] 14. The system of claim 10, wherein where the shape di-

rection is clockwise, the selecting means selects the point code to be:

- a) for a vertical up previous edge orientation: HYLX for a horizontal LtoR next edge orientation and LYLX for a horizontal RtoL next edge orientation;
- b) for a vertical down previous edge orientation: HYHX for a horizontal LtoR next edge orientation and LYHX for a horizontal RtoL next edge orientation;
- c) for a horizontal LtoR previous edge orientation: HYLX for a vertical up next edge orientations horizontal LtoR and HYHX for a vertical down next edge orientation; and
- d) for a horizontal RtoL previous edge orientation: LYLX for a vertical up next edge orientation and LYHX for a vertical down next edge orientation.

[c15] 15. The system of claim 11, wherein where the shape direction is counter-clockwise, the selecting means selects the point code to be:

- a) for a vertical up previous edge orientation: LYHX for a horizontal LtoR next edge orientation and HYLX for a horizontal RtoL next edge orientation;
- b) for a vertical down previous edge orientation: LYLX for a horizontal LtoR next edge orientation and HYHX for a horizontal RtoL next edge orientation;
- c) for a horizontal LtoR previous edge orientation:

LYHX for a vertical up next edge orientations horizontal LtoR and LYLX for a vertical down next edge orientation; and

d) for a horizontal RtoL previous edge orientation:  
HYHX for a vertical up next edge orientation and  
HYLX for a vertical down next edge orientation.

[c16] 16. A computer program product comprising a computer useable medium having computer readable program code embodied therein for merging an original circuit shape and at least one clone of the original circuit shape of an IC design, the program product comprising:

program code configured to determine, for a cell including an original circuit shape and at least one overlapping clone of the original circuit shape, whether each clone corner point of each overlapping clone is within a threshold distance of a corresponding original corner point of the original circuit shape; and

program code configured to generate, in the case that each clone corner point of each overlapping clone is within the threshold distance, a union of each overlapping clone and the original circuit shape such that the union does not contain a notch.

[c17] 17. The program product of claim 14, wherein the generating program code includes:



program code configured to determine a shape direction of the original circuit shape;

program code configured to determine, for each original corner point of the original circuit shape that has at least one corresponding clone corner point that is not identical to the original corner point, a previous edge orientation and a next edge orientation;

program code configured to, for each original corner point having a previous and next edge orientation: select a point code from a plurality of point codes based on the previous and next edge orientations and the shape direction, the point code indicating which X coordinate and which Y coordinate among an original corner point and at least one corresponding clone corner point is selected to generate a union corner point;

compare respective coordinates of the original corner point and each corresponding clone corner point and selecting an X coordinate and a Y coordinate for the union corner point based on the point code; and

program code configured to generate the union based on any union corner points.

- [c18] 18. The program product of claim 17, wherein:  
the previous and next edge orientations are each one

of: vertical up, vertical down, horizontal left-to-right (LtoR), and horizontal right-to-left (RtoL); the shape direction is one of clockwise and counter-clockwise; and the point code includes high Y, low X (HYLX); high Y, high X (HYHX); low Y, low X (LYLX) and low Y, high X (LYHX).

[c19] 19. The program product of claim 17, wherein the shape direction determining program code determines the shape direction based on an order in which points appear in a construction list for the IC design.

[c20] 20. The program product of claim 17, further comprising program code configured to conduct a ground rule fix-up of the union.